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Redescription and transfer of *Geolycosa grandis* (Araneae, Lycosidae) to the genus *Hogna*

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Abstract. *Geolycosa grandis* (Banks 1894) (Araneae, Lycosidae) is redescribed, and illustrations are provided for the first time. We propose that *Geolycosa grandis* be transferred to the genus *Hogna* Simon 1885. *Hogna permunda* (Chamberlin 1904) is synonymized with *H. grandis*. Notes are given on distinguishing *H. grandis* from similar species including *H. helluo* (Walckenaer 1837), *Allocosa georgicola* (Walckenaer 1837), and *H. aspersa* (Hentz 1844). Information on *Lycosa permiana* Scheffer 1904 is examined and the species is declared *nomen dubium*.

Keywords: Wolf spider, taxonomy, synonymy, new combination, *nomen dubium*

Geolycosa grandis (Banks 1894) is a large wolf spider found throughout the north central Great Plains of North America. Although a large wolf spider, arachnologists have routinely overlooked or misidentified the animal almost from the time of its original description. Banks's original 1894 description provides an adequate depiction of *Lycosa grandis* for correct identification. However, likely due to a lack of illustrations, the species has remained obscure to date. Chamberlin, who described the spider as *Lycosa permunda* in 1904, had apparently either not read or misunderstood Banks's original description. Chamberlin included both *L. permunda* and *G. grandis* (as *Lycosa grandis*) in his lycosid revision of 1908; however, Chamberlin indicates that he had not examined Banks's type specimen of *L. grandis* from Colorado; he only had studied a specimen he identified as *L. grandis* from Baja California. It is not known what species Chamberlin identified as *L. grandis* from Baja as the specimen referred to could not be located. Research conducted for this paper indicates that the range of *L. grandis* does not extend that far south.

We contacted any institution that might have possession of the type *L. permunda*, including the American Museum of Natural History, United States National Museum, Museum of Comparative Zoology at Harvard University, University of Kansas Natural History Museum, and Brigham Young University Museum. In his description, Chamberlin makes note of a spider having a carapace length over 10 mm and a "pale narrow median line extending backward from first eye row, widening abruptly in front of dorsal groove." He also mentions a clear abdominal pattern, light venter, and an epigynum as in *Hogna helluo* (Walckenaer 1837). The lack of another spider having these characters in the Colorado/Kansas area indicates it is *G. grandis*.

The holotype male of *Lycosa grandis*, deposited at the Museum of Comparative Zoology, was found in a vial with a male *L. coloradensis* Banks 1894 and a female *Agelenopsis aperta* Gertsch 1934. It is not clear why these specimens are together in the type vial. *Lycosa grandis* was transferred to *Geolycosa* by Roewer (1955); however, the reason for this transfer was not made clear.

The proposed transfer of *Geolycosa grandis* into the genus *Hogna* is based on comparisons with the generotype *Hogna radiata* (Latreille 1817) from Montpellier, France, provided by Charles Dondale (the holotype is presumed lost), as well as comparisons with other North American representatives of the genus *Hogna*. The species is placed into *Hogna* based on similarities of the palpal structure, specifically the similar median apophysis shape, the two-part terminal apophysis, and the palea shape. The species also shares similarities in the internal and external epigynal structures, specifically the spermathecal shape, as well as similarities in the carapace shape, eye location, and leg length. Illustrations of *H. grandis* are provided here for the first time.

Justification for the removal of *H. grandis* from *Geolycosa* is also supported by the lack of characteristics diagnostic for *Geolycosa*, specifically the lack of a sloped carapace, a defining character for the genus *Geolycosa* (Wallace 1942; Dondale & Redner 1990). In addition, the species differs behaviorally. According to Wallace (1942), spiders of the genus *Geolycosa* spend practically their whole existence in a burrow and females rarely leave the burrow. In contrast, *G. grandis* is a non-obligate burrower and the females spend considerable time roaming outside the burrow.

METHODS

Illustrations were made from digital photographs taken with an Olympus U-CMAD3 digital camera mounted on an Olympus SZX12 stereo-microscope. Scanning electron micrographs were taken with a Hitachi TM-1000 tabletop microscope. All measurements are in millimeters. Specimens used for this study are housed in the arachnological collection at the Denver Museum of Nature & Science, the University of Nebraska Museum, and the Museum of Comparative Zoology at Harvard University. Specimens of comparison species are also housed in the DMNS collection.

Abbreviations.—MA = median apophysis; TA= terminal apophysis; MS = median septum; PLE = posterior lateral eyes; PER = posterior eye row; AME = Anterior median eyes; AMNH = American Museum of Natural History; BYU = Brigham Young University; DMNS = Denver Museum of Nature & Science; KU = Kansas University; MCZ = Museum of Comparative Zoology; USNM = United States National Museum, Smithsonian Institution.

TAXONOMY

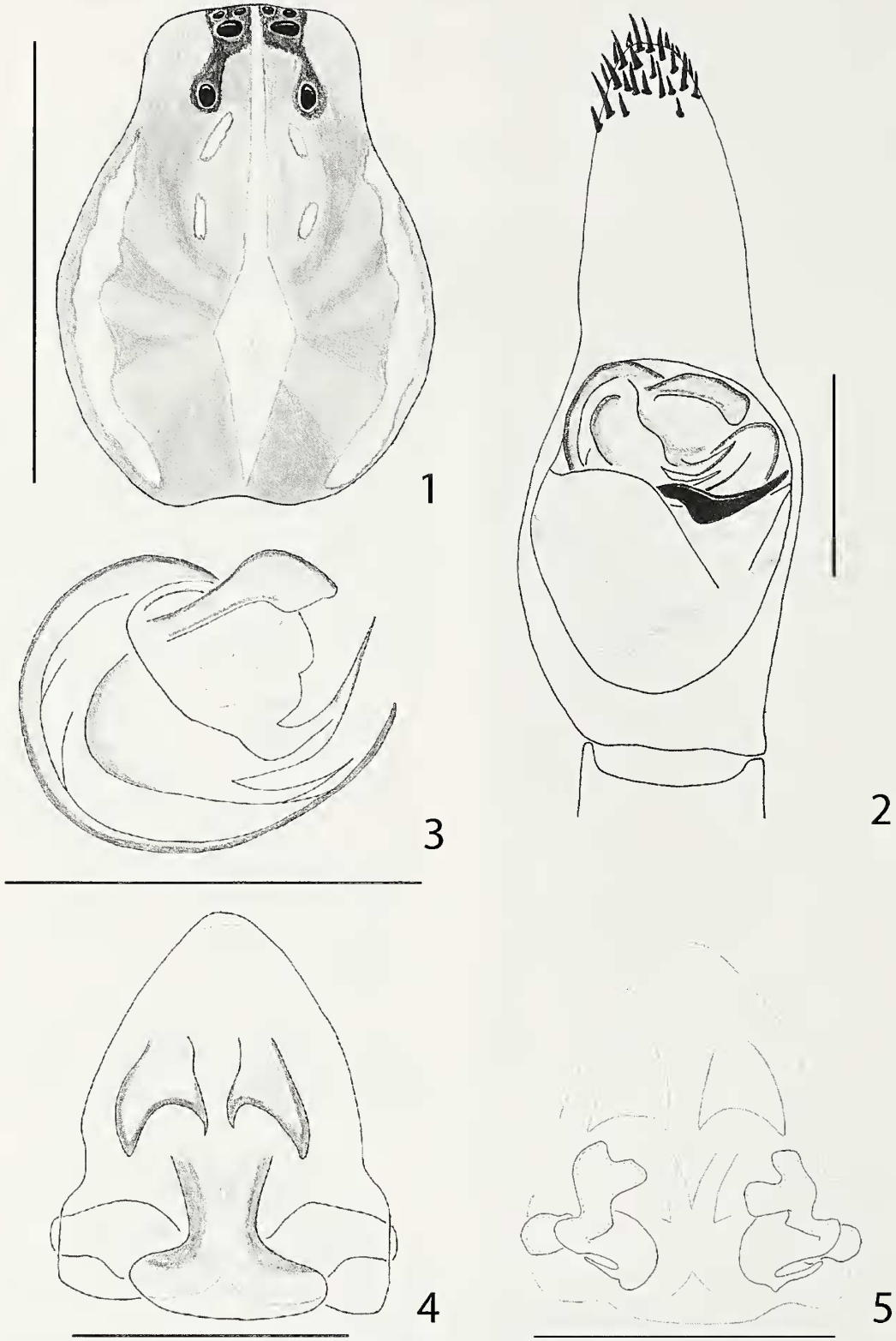
Hogna grandis (Banks 1894) new combination

Figs. 1–6

Lycosa grandis Banks 1894:49; Chamberlin 1908:229.
Lycosa permunda Chamberlin 1904:286; Chamberlin 1908:233, NEW SYNONYMY.
Hogna permunda Roewer 1955: 259; Platnick 2008.
Geolycosa grandis (Banks 1894) Roewer 1955:244; Platnick 2008.

Type material.—*Holotype:* USA: COLORADO: *Larimer County*, Fort Collins (40.35°N, 105.05°W, elev. 1525 m), male, no date, MCZ. Examined.

Holotype male and paratype female: Lycosa permunda Chamberlin 1904: USA: Kansas, no date. Unable to locate specimens.



Figures 1–5.—*Hogna grandis* (Banks 1894). Figs. 1–3. Male (DMNS. ZA11887): 1. Dorsal view of carapace; 2, 3. Ventral view of palpus; p = palea, MA = median apophysis. Figs. 4,5. Female (DMNS. ZA.9572): 4. Ventral view of epigynum; 5. Dorsal view of spermathecae; bc =basal chamber, ll = lateral lobe, tc = terminal chamber, ss = spermathecal stalk. Scale line = 1 m.

Figures 6, 7.—Scanning electron micrographs of male palpus. 6. *Hogna grandis* (Banks 1894); 7. *Hogna helluo* (Walckenaer 1837).

Other material examined: 17 males and 25 females; USA: COLORADO: *Arapahoe County*, 1M, 21309 E. Belleview (40.58°N, 106.23°W), no date, B. Parshley, DMNS ZA.12744; 1F, Aurora (39.65°N, 104.75°W), 20 August 2001, B. Shipley, DMNS ZA.12740; 1F, I-70, 0.5 mi (0.8 km) N of Elbert Co. Line (39.58°N, 104.02°W), 30 August 2004, H. Guarisco, DMNS ZA.9572; *Boulder County*, 1F, 2 mi (3.2 km) E. Marshall (39.96°N, 105.23°W), 16 April 1961, B. Vogel, DMNS ZA.2128; 1M, Boulder (40.02°N, 105.31°W), 31 July 1961, D. Ward, DMNS ZA.2129; *Delta County*, 1M, North entrance Crawford State Park (38.70°N, 107.60°W), 31 July 1999, C. Swinney, DMNS ZA.12738; *Denver County*, 1F, Washington Bay in Denver near Southwest Plaza (39.83°N, 105.20°W), October 1998, D. M. Endricks, DMNS ZA.12739; *Douglas County*, 1M, 10615 Jewelbenny Trail, Highlands Ranch (39.32°N, 104.93°W), 17 August 2006, no collector given, DMNS ZA.13376; 1F, 6414 E. Dutch Creek St., Denver (39.71°N, 104.99°W, 12 August 2000, N. & J. Tuchton, DMNS ZA.12737; 1F, Sharptail Open Space, Louviers (39.45°N, 105.05°W), 27 May 2005, B. Morrison, DMNS ZA.14252; *El Paso County*, 1F, Bilerest Terrace (38.88°N, 104.76°W), 16 July 2001, A. Broughton, DMNS ZA.11888; *Jefferson County*, 1M, 9797 West Ohio Avenue, Lakewood (39.70°N, 106.11°W), August 2001, E. House, DMNS ZA.12721; *Larimer County*, 1M, 1756 Haase Court, Berthoud (40.31°N, 105.81°W), 18–20 August 1999, P. Phillips, DMNS ZA.12731; 1F, 2120 Bridgefield Ln, Ft. Collins (40.56°N, 105.10°W), 29 August 2004, J. Enstrom, DMNS ZA.13770; 1F, 24205 Colorado Ave, Loveland (40.37°N, 105.08°W), 30 July 1999, D. Goldade, DMNS ZA.11840; 1F, 7894 Little Fox Lane, Wellington (40.70°N, 105.00°W), 14 September 2000, M. Payew, DMNS ZA.11883; 1F, Dixon Reservoir (40.55°N, 105.14°W), 24 May 2000, D. Chlebown, DMNS ZA.11886; 1F, Environmental Learning Center (40.57°N, 105.01°W), 25 September 1999, J. M. Diez, DMNS ZA.11882; 1F, Fort Collins (40.58°N, 105.11°W), 30 August 1973, W. D. Frank, DMNS ZA.11875; 1M, Same locale, 10 August 1970, W. D. Frank, DMNS ZA.11880; 1M, Same locale, 24 November 1980, W. D. Frank, DMNS ZA.11881; 1M, Same locale, 9 August 1987, D. Johnson, DMNS ZA.11872; 1F, Same locale, 13 Jun 1989, B. Holter, DMNS ZA.11797; 1M, Same locale, 4 March 1985, W. D. Frank, DMNS ZA.11879; 1F, Same locale, 15 July 1980, W. D. Frank, DMNS ZA.11877; 1F, Same locale, 4 January 1971, W. D. Frank, DMNS ZA.11876; 1M, Same locale, 23 September 2001, L. Sandner, DMNS ZA.12698; 1F, Same locale, 11 September 1990, no collector given, DMNS ZA.11874; 1M 1F, Same locale, 1 September 1977, W. D. Frank, DMNS ZA.11873; 1F, Same locale, 18 September 1973, W. D. Frank, DMNS ZA.11878; 1F, Same locale, 22 October 1982, D. Clarkson, DMNS ZA.11798; 1F, Loveland (40.40°N, 105.11°W), 10 October 1967, W. D. Frank, DMNS ZA.11885; 1M, Same locale, 7 August 1990, Kilburn, DMNS ZA.11884; 1M, Loveland (40.40°N, 105.11°W), no date, A. Randall, DMNS ZA.12718; *Weld County*, 1M, Bones Galore Paleo Site, Pawnee National Grassland (40.73°N, 103.80°W), 15 August 2001, T. Hiester, DMNS ZA.11887; 1F, Bones Galore Paleo Site, Pawnee National Grassland (40.75°N, 103.80°W), 18 August 2000, T. Hiester, DMNS ZA.12722; KANSAS: *Montgomery County*, 1F, 1 mi (1.6 km) E Havana Reservoir (37.22°N, 95.71°W), 25 July 1974, no collector given, DMNS ZA.11306; *Wyandotte County*, 1F, Mission Grade School 2 mi (3.2 km) N. Bonner Springs (39.06°N, 94.88°W), 29 September 1977, R. Huggins, DMNS ZA.11308; 1M, Mission Grade School, 3 mi (4.8 km) N. Banner Springs (39.16°N, 94.83°W), 29 September 1977, R. Hugging, DMNS ZA.11841; WYOMING: *Campbell County*, 1M 1F, Gillette (44.29°N, 105.50°W), June 2005, no collector given, DMNS ZA.14260.

Diagnosis.—*Hogna grandis* can be diagnosed by its size, total length over 20 mm; carapace length about 10 mm; a clear median band on the carapace originating from between the AME and expanding just anterior to and around the fovea, forming a diamond or triangle shape; undulating sub-marginal bands; light marks just behind the PLE (Fig. 1); and a patterned abdomen. Male *H. grandis* specimens can be separated from *H. helluo* and *A. georgicola* by the short laterally directed MA (compare Figs. 6 and 7), and from *H. aspersa* males by the color pattern, and a weak or absent sclerite on the palea (Figs. 2, 3). Female *H. grandis* can be separated from *H. aspersa* by a narrower inverted T-shaped MS, which is no wider than one of the epigynal hoods. They can be separated from *H. helluo* by a shorter MS stalk and thicker MS base, and from *A. georgicola* by a less curved atrium and thicker MS base which forms a gradual curve from the stem to the base without depressions along the curve. The bilobed terminal chamber of the spermathecae of *H. grandis* can be used to separate it from female *A. georgicola* and *H. aspersa*.

Description.—*Male (type):* Total length 21.80 mm, carapace length 11.40 mm, carapace width 8.76 mm. Pale median band originating between the AME and abruptly widening just prior to the fovea, then narrowing again posteriorly, creating a diamond shape. Broad pale marginal bands extending from the PER posteriorly, margins of bands often undulating. Light yellow stripe just posterior to each of the PLE, just longer than the length of the PLE, followed by a second light yellow stripe about the same length just posterior to the first stripe. Chelicerae dark brown, endites dark brown with lighter tips. Sternum brown, with a lighter median band. Legs light brown except for tarsus, which is black, covered with hair-like setae. Numerous macrosetae present. Abdomen with dark heart mark followed by several chevrons, each ending with a light mark. Venter light brown, covered with many scattered dark spots. Cymbium with 14 macrosetae at tip. Embolus originating from the distal area behind the palea and smoothly curving until terminating on the retrolateral side below the end of the upper TA sickle. Palea with a distally located, laterally directed weakly sclerotized area. MA

Figure 8.—Collection localities of *Hogna grandis* (Banks 1894).

small, triangular, located on the retrolateral side of the palp, projecting laterally, but not beyond the cymbium border. TA double, sickle-shaped.

Males (n = 8): Total length: 18.2–22.0 mm; carapace length: 8.90–12.33 mm; carapace width: 7.2–10.12 mm. Carapace median band (Fig. 1) may terminate in a more triangular shape than diamond. Second set of light marks just posterior to PLE may be hard to see or absent. Chelicerae may appear black. Sternum various degrees of brown from light to dark. Cymbium may have 10–20 thick macrosetae at the tip. Weakly sclerotized area of palea may appear non-scelerotized (Fig. 3). Size of MA consistent (Fig. 2) relative to the rest of the palp. TA lower sickle not always visible (Fig. 3).

Females (n = 11): Total length: 18.2–23.6 mm; carapace length: 11.2–12.6 mm; carapace width: 8.7–9.8 mm; coloration same as male but darker. Marginal bands of carapace thinner, light marks behind PLE often lacking second light mark set. Legs also darker than male. Females have an inverted T-shaped MS with a narrow stem no wider than one of the epigynal hoods. The base of the MS is thick forming a gradual curve from the stem to the base without depressions along the curve (Fig. 4). The spermathecae have a kidney-shaped basal chamber with a lateral lobe not extending anteriorly beyond the basal chamber. The spermathecal stalk has a globular lateral lobe and an oblong and often bilobed terminal chamber (Fig. 5).

Habitat and distribution.—Specimens of *H. grandis* have been collected in the grasslands east of the Rocky Mountains in Wyoming and Colorado and west into the San Luis Valley of Colorado (Fig. 8). There is some discrepancy in the distribution of the species. Chamberlin (1904) lists the locality of *L. permunda* as being in Kansas, but provided no further information. Worley & Pickwell (1931), in their Spiders of Nebraska, had their lycosid spiders identified by Martin Muma; examination by the author (JS, pers. obs.) of all voucher specimens in the UNB museum found that he had mistakenly identified specimens of *H. helluo* (Walckenaer 1837) as *H. (Geolycosa) grandis*. No specimens of *H. grandis* were found in the voucher set; however, not all specimens listed by Worley & Pickwell could be located. Worley & Pickwell also note that *H. (Geolycosa) grandis* is found only in the eastern half of the state, which is peculiar for a species with a type locality of Fort Collins, Colorado.

More recently Dondale & Redner (1990) cite both *H. helluo* and *H. aspersa* (Hentz 1844) as being found in Colorado and Wyoming; however, upon review of specimens from both states held in the DMNS collection, no *H. aspersa* have been found, and only a single *H. helluo* male was collected in Colorado, indicating that ranges for both species occur further east. The DMNS collection consists of specimens collected since 1998, as well as the private collection of Bea Vogel; therefore, the specimens may not have been available to Dondale & Redner. These species can be confused with *H. grandis*, which may explain the discrepancy.

Spiders have been seen using burrows and roaming at night in search of prey, a behavior similar to *Hogna carolinensis* (Walekenaer 1805) (JS, pers. obs.). They also use perches when kept in captivity, another behavior similar to *H. carolinensis*. Burrow depth is variable from 5–10 cm, with adults preferring shallower burrows. Burrow shape is straight with a small cavity at the base in deeper burrows, and more lateral in shallower burrows. Burrow turrets were not observed.

Taxonomic note.—In researching this paper, we examined Scheffer's (1905) description and illustrations of *Lycosa permiana*, which indicate that the spider is not a *Lycosa*, but rather belongs in the genus *Arctosa*. The type specimen of *L. permiana* could not be located at the KU museum or USNM as indicated in this paper. The type specimen could also not be located at the AMNH or MCZ collections and is assumed lost. Based on the illustrations of the dorsum and epigynum showing the median septum gradually widening posteriorly and appearing covered with hairs, as well as the description of the dorsum of the carapace and abdominal pattern with radiating lines and spots rather than a dark heart mark found in *Hogna*, *L. permiana* may be synonymous with *Arctosa emertoni* Gertsch 1934 or *A. rubicunda* (Keyserling 1877) which both occur in Kansas. Because of the uncertainty about which *Arctosa* species it may be, we declare it *nomen dubium*.

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